

50X1-HUM

Basic Problems in Complex Mechanization of Construction

Osnovnyye <sup>9)</sup>Zadachi Kompleksnoy Mekhanizatsiya Stroitel'stva,  
By A. V. Konorov, Member, Technical Council for Mechanization  
of Labor-Consuming and Heavy Work Attached to Council of  
Ministers USSR. Mekhanizatsiya Trudoyemkikh i Tyazhelykh Rabot,  
Moscow, Apr 1947

50X1-HUM

## CONFIDENTIAL

### BASIC PROBLEMS IN COMPLEX<sup>x</sup> MECHANIZATION OF CONSTRUCTION

The program of the post-war Five-Year Plan for restoration and development of the USSR national economy calls for a centralized capital outlay in construction, not including kolkhoz and individual construction, of 250.3 billion rubles, to be allotted in the following proportions: for industrial construction, 63 percent; living quarters, 14.5 percent; railways, 17 percent; automobile roads, 5 percent; miscellaneous, 0.5 percent. This means that about one sixth of the USSR national income is going into capital construction.

Over 2 million workers and employees are directly involved in construction operations. This number is doubled by adding workers engaged in the construction materials industry and in transportation activities serving construction work. It may tentatively be assumed that one of every six or seven workers and employees in the Soviet Union is engaged in construction work.

Shipments to construction sites comprise one-fifth of all goods carried by the country's railroads.

The postwar Five-Year Plan calls for 153 billion rubles worth of actual construction, earmarking the remaining 97.3 billion rubles to pay for equipment. The volume of construction work will increase from the 27 to 28 billion rubles worth completed in the first year of the Five-Year Plan, to the 38- to 39-billion-ruble outlay scheduled for the last year of the plan. Thus the 1950 volume of work is to be <sup>approximately</sup> 35 percent greater than that of 1946. Since it is planned to reduce construction costs 12 percent during the 5-year period, the 1950 physical volume of work should amount to about 155 percent of the 1946 total.

The Five-Year Plan provides for a 40-percent increase in labor productivity over the 1941 level. The war cost the construction industry a considerable number of its manufacturing plants, machines,

- 1 - **CONFIDENTIAL**

**CONFIDENTIAL**

and mechanisms. Many skilled workers were replaced by unskilled ones, with a resultant drop in labor productivity. During the current five-year period, labor productivity must be raised 72 percent over the 1946 figure.

Retaining the above figure of 2 million construction workers, and assuming a constant yearly volume of work, the planned rise in labor productivity should make it possible to reduce <sup>the</sup> labor <sup>force</sup> by 840,000 workers. Thus, although the volume of construction work increase steadily during the Five-Year Plan, no increase in <sup>the</sup> labor <sup>force</sup> will be required; on the contrary, it should be reduced 11 <sup>(to)</sup> 12 percent below the 1946 total.

To increase its labor productivity and cut its costs, the construction industry must take certain organizational measures, industrialize construction output and production of semi-fabricated units and parts, and mechanize construction and loading operations. This last subject, mechanization, will be considered in this article.

The graph [on page 6 of source document] shows the dynamic growth of labor productivity and the ~~coefficient~~ of mechanical resources [mekhanovozruzhennast'] of the USSR construction industry. By coefficient of mechanical resources we mean the ratio of the cost of all mechanical resources used in construction (not including equipment belonging to industrial enterprises) to the cost of the year's construction program.

According to the graph, labor productivity and the level of mechanical resources in construction increased at the same rate during three prewar Five-Year Plans. The 480-percent increase in labor productivity during that period <sup>was</sup> ~~was~~ achieved partly by the growth of mechanical resources and rise in mechanization of production; <sup>ment</sup> improve in the organization of construction and its industrialization contributed just as much.

**CONFIDENTIAL**

# CONFIDENTIAL

Thus, during the current Five-Year Plan, mechanical construction resources should continue to increase at the same rate as labor productivity, or about 72 percent in comparison with the 1946<sup>1</sup> level. Since the coefficient of mechanical construction resources was 10 percent in 1946, it should reach 17.5 percent in 1950.

This means that the park of construction machinery (given in cost) amounting to 2.75 billion rubles worth in 1946, should amount to 6.75 million rubles worth in 1950.

The very same coefficient of mechanical resources and the same size of the machinery park for the new Five-Year Plan was arrived at in the detailed estimates of the All-Union Scientific-Research Institute for Organizing Construction Mechanization (VNIOMS), which <sup>were</sup> ~~was~~ carried out by a quite different method in working out machine-building plans for the period 1946 to 1950.

The effect of the indicated capital outlay may be seen when it is noted that one [Construction-] machine builder's production makes up for that of 15 workers engaged in construction.

Construction work entails an extensive <sup>materials</sup> ~~goods~~ turnover. On an average, one million rubles spent on construction, <sup>requires</sup> ~~will get~~ 8,000 to 10,000 tons of various construction materials and semi-fabricated items, and ~~will take care of~~ the digging of 12,000 to 15,000 tons of earth.

From 1.3 to 1.4 tons of <sup>materials</sup> ~~goods~~ per worker are reprocessed each shift. If it is taken into account that all <sup>materials</sup> ~~goods~~ going into construction, undergo not just one, but two or three transfer processes (from the basic stock pile to the outgoing stock pile, and finally onto the structure itself); then the <sup>materials</sup> ~~above-mentioned~~ [turnover] index will be increased 2 to 3 times. A detailed analysis shows that transport and transfer operations take from 60 to 75 percent of all labor engaged in construction; only 25 to 40 percent of all labor is expended ~~in~~ in

# CONFIDENTIAL

processing materials or semi-fabricated items, and <sup>in joining various</sup> ~~on every~~ kinds of construction part<sup>s</sup> and structure<sup>s</sup>.

After the war, there was a sharp increase in the level of unskilled workers: ordinary laborers and workers carrying out loading and digging operation now make up over 52 percent of the total number of construction workers. Construction suffers its greatest labor ~~[-efficiency]~~ losses in loading and earth-moving work performed by unskilled workers. Complex mechanization of these two kinds of work should take first place in the overall mechanization efforts of the postwar Five-Year Plan.

At a conference of construction workers of the Technical Council for Mechanization of Labor-consuming and Heavy Work attached to the Council of Ministries USSR, in March 1947, the importance of mechanizing loading and earth-moving operations was emphasized by representatives of all ministries. It was pointed out at this conference that while the mechanization means at construction sites <sup>are</sup> ~~was~~ extremely inadequate, even the few mechanisms which are available are not fully utilized.

The following table gives indexes for <sup>generalized</sup> ~~various~~ <sup>a number of</sup> ministries on the <sup>[yearly]</sup> production ~~fulfillment~~ of basic types of construction machines for 1946.

Types of Machines	Output Norms	Fulfillment of norms in percent:	
		for Individual Main Administrations	Average
Single-bucket <sup>ed</sup> excavators	100,000 cu m <sup>per</sup> <del>bucket</del> <sup>1 cu m capacity</sup>	28 - 91	63
Self-propelled cranes	Average of 1,800 tons <sup>per</sup> <del>1-ton nominal capacity</del>	24 - 141	53
Rock crushers	1,000 cu m <sup>per</sup> <del>1 cu m/hr nominal productivity</del>	6 - 66	40
Concrete mixers	12,000 cu m <sup>per</sup> <del>1 cu m nominal chamber volume</del>	12 - 50	33
Mortar mixers	12,000 <sup>per</sup> <del>1 cu m nominal chamber volume</del>	19 - 69	53

**CONFIDENTIAL**

- 4 -



## CONFIDENTIAL

If the construction equipment on hand had been properly used, 1946 production would have been double the actual amount. The chief causes for the inadequate utilization of the park, beyond purely organizational ones, were the following:

Poor integration of machine groups. Work of the excavators had to be stopped frequently to wait for trucks and railroad cars to take away the earth, while more than half the small park of large scrapers at construction sites ~~were~~<sup>+</sup> were idle because they lacked towing units. Loading of railroad cars and trucks was delayed because of a shortage of mechanical loaders and cranes.

Insufficiency of types and sizes; obsolescence of machines. The construction industry has <sup>industrial models of</sup> absolutely no tractor-mounted shovels for loading <sup>free-flowing materials</sup> dry goods ~~shown~~<sup>shown</sup> in two photos, lower left, page 7 of source document<sup>7</sup>. There are no small truck-mounted excavators, which could easily get to and from small construction jobs. Even the universal ~~machines~~<sup>machines</sup> which can be rigged as<sup>7</sup> excavators and cranes ~~shown~~<sup>shown</sup> in photo, upper right, page 7 of source document<sup>7</sup> are seldom found on construction jobs, and when they are, full use is not made of all their possible rigs.

A forward step in domestic machine building may be seen in the new DA-0.25/5 truck-mounted excavator, an experimental model of which is now undergoing tests. Using the same bucket, it can be rigged as a forward shovel and <sup>e</sup>tr<sup>e</sup>nch hoe<sup>e</sup>; <sup>e</sup>the<sup>e</sup> dipper stick for the forward-shovel rig can be affixed to the boom, extending its length to take a crane rig. Such unification of working parts is unknown in the United States.

Self-dumping transport equipment, such as railroad dump cars and trucks, are found in negligible quantity at construction sites. Concrete and mortar mixers, numbering thousands, are nearly all of only moderate size -- of 150 to 375 litres capacity. Working on individual small projects, they are not utilized to their capacities.

## CONFIDENTIAL

**CONFIDENTIAL**

Where 4 to 8 of these moderate-sized machines are used in centralized concrete plants instead of 1 or two large mixers, operation of the plant is rendered unnecessarily complex, and the labor productivity is reduced 4 to 5 times as a result. (1)

The scope of mechanization. Despite the present deplorably inadequate level of mechanization in the construction industry, ministries cite individual instances of surpassing certain mechanization goals set by the Five-Year Plan for 1946. The Ministry of the Construction of Heavy Industry Enterprises reports that special trusts have mechanized earth-moving operations 85 percent, whereas the plan called for only 60 percent mechanization of this construction activity by 1950. The 1946 preparation of concrete and mortar by the majority of ministries was reported mechanized in excess of the quota set for 1950.

The disparity between the actual situation and the individual instances reported by the ministries is explained by the fact that in calculating the scope of mechanization, the ministries completely ignore the extent to which mechanization has been integrated. For example, if earth is dug out by an excavator, and unloaded, levelled, and tamped down by hand, all the work coming under the heading of extraction is called "mechanized", even though 60 to 100 workers are needed to unload and level the earth which the excavators and transport vehicles have dug out and moved <sup>to</sup> the dumping place. Preparation of concrete is said to be 100 percent mechanized when the concrete mixer is assumed to be the only factor in this operation. This rating takes absolutely no account of the fact that in the preparation process 6-10 workers are required to load the ingredients of the concrete into the mixer. Furthermore this method of reckoning mechanization draws <sup>per worker</sup> no distinction between preparation in individual concrete plants, where 10 cubic meters are produced <sup>per shift</sup>, and preparation in individual mixers, where 70 cubic meters and more are produced <sup>per worker</sup> per shift.

**CONFIDENTIAL**

## CONFIDENTIAL

Such disregard for all the factors coming within the province of mechanization is most unsatisfactory, and calls for rectification of the rating method for mechanization achievements.

Accompanying the problem of increasing the machinery available to construction activities, is the one of bringing about full <sup>u</sup> utilization of equipment now available. The following points are of foremost importance in this matter.

Now -- during 1947 -- the available park of machinery should be put into complete operating condition, subjecting it to capital repairs and renovation where necessary. All the ministries have <sup>to prepare</sup> failed for such an undertaking. The organizations and enterprises which were turning out spare parts for construction machines before 1941 have not yet been restored; repair plants have not been put into order. <sup>el</sup> Operation, care and maintenance programs are so bad that new equipment is threatened with damaging misuse. Solution of the entire problem is dissipated <sup>among</sup> in "functional" <sup>divisions</sup> details and there is no responsible direction to handle it.

A detailed redistribution of equipment on hand should be made, supplementing it with machines needed to integrated <sup>el</sup> mechanization. New excavators must not be sent to construction sites if those on hand cannot be efficiently employed because of a shortage of earth-hauling vehicles; nor should new scrapers be acquired by builders who lack hauling units for them. The experience of specialized construction enterprises, such as Soyuzekskavater <sup>siya</sup>, and Stal'konstruktsiya in developing rayon machine-renting bases must be made broadly available.

The manufacture of special attachments must be developed in the construction-site shops. Special attention in this respect should be devoted to the efforts of the Soyuzstal' konstruktsiya Trust, which <sup>extension</sup> makes booms for its cranes.

All ministries must raise the qualifications and bolster the ranks of their mechanization specialists.

## CONFIDENTIAL



## CONFIDENTIAL

Production of new, <sup>e</sup> machinery resources for construction work.

A number of organizations (the Technical Council of the former Peoples' Commissariat of Construction, the VNIOMS, the Academy of Architecture, the Technical Council for Mechanization attached to the Council of Ministers USSR, and others) have made estimates of the machinery resources required for the integrated mechanization of construction in accordance with the directives of the Five-Year Plan.

If it is assumed that the production of <sup>billion</sup> 4 ~~million~~ rubles worth of new machines will be covered during four years by the average yearly production of one billion rubles worth of them, and that for the replacement of normally depreciated machines, there will have to be an additional yearly output of 450 million rubles worth of machines (about one-sixth to one-seventh the park on hand); then the following yearly amount of equipment must be produced.

1. Transport Equipment:

- (a) Trucks -- 450 million rubles worth
- (b) Tractors -- 150 million rubles worth
- (c) Railroad trains -- 80 million rubles worth

2. Excavator-crane, hoist and transport machinery:

- (a) Single-bucket excavators and self-propelled cranes -- 300 million rubles worth.

- (b) Loaders, hoists, winches, etc -- 100 million rubles worth

3. Construction and road machinery -- 150 million rubles worth

4. Power equipment (Electric power stations, compressors, etc.) -- 100 million rubles worth.

5. Power tools (pneumatic and electric) -- 20 Million rubles worth

6. Miscellaneous equipment -- 100 million rubles worth

The machine building establishment, as of 1947, is far from meeting these requirements [-- presumably, production of all items in proper proportion]. Still unresolved is the question <sup>of</sup> whether to place the production of construction equipment with other branches of the machine-building industry, or to build new plants.

## CONFIDENTIAL

## CONFIDENTIAL

New technology in construction-machine building. Enterprises which were turning out construction machinery prior to 1941, ran below par both in the quality of their products and in the integration of of machines in the products-list. Since the start of the war, this branch types and sizes of machine building has generally curtailed its output; it did not begin to expand production until the end of 1946.

The Ministry of Construction- and Road-Machine Building fulfilled the 1947 first-quarter plan 103 percent, but the volume produced did not come up to construction needs.

The Technical Council for Mechanization attached to the Council of Ministers USSR, together with the ministries concerned, drew up a list of products to be put into production during the current Five-Year Plan; they should provide sufficiently integrated construction mechanization.

New technology of construction and road machine building must be founded on the following points:

(a) Complete integration of the products-list. This problem is one of coordinating the various branches of the machine building industry. Production of heavy excavators (3-cubic-meters capacity and greater), for example, should be coordinated with that of heavy dump cars and dump trucks. Production of truck-mounted concrete mixers should be geared with production of automatic units for rayon preparation of dry concrete ingredients, and so forth.

(b) Repudiation of the production of an exceedingly large number of types and sizes of machines coming under the same designation, as is done in <sup>the US</sup> ~~America~~, and the avoidance of intermediate types and sizes. For example, instead of producing the series of excavators established by <sup>(State All-Union Standard)</sup> ~~the GOST~~ of 1, 1.5, 2, and 3 cubic meter capacity, a series of 1, 2 and 3 cubic meters capacity is being adopted; and instead of the series of concrete mixers on hand before 1941 of 250, 375, 500, and 1,000 litres capacity, a series of 250, 425, and 1,200 litres capacity is being adopted, and so forth.

## CONFIDENTIAL

## CONFIDENTIAL

(c) Mobile and non-dismountable machines. Among such machines are heavy scrapers for moving and levelling out earth [shown in upper right, page 9 of source document]; hoists mounted on slides or carriages and equipped with winches, of the type already put out by the Moscow Experimental Plant of the Ministry of Construction- and Road-Machine Building [shown in lower left, page 10 of source document]; heavy cranes running on pneumatic tire<sup>s</sup> and not equipped with outriggers [shown in upper right, page 10 of source document]; and mobile quarry concentrating plants. All these machines are being put into production.

(d) Production of loading and unloading equipment -- of especial interest. The desirable reduction in labor consumption is possible only if enough of these machines such as self-propelled <sup>load-flowing</sup> dry-goods <sup>materials</sup> loaders, cranes for handling single items, dump trucks, and containers are utilized. The situation in this field gives considerable reason for alarm, as neither the Ministry of Construction and Road Machine Building, nor other ministries are devoting sufficient efforts to the production of such machines.

(e) Full utilization of standard tractors and trucks as basic units for a great number of construction machines, such as bulldozers, loaders, cranes, drilling machines, pipe-layers, rooters, and pile drivers. These mass-produced machines cost 30 to 4 times less per ton than do machines in the average-series production class. These machines have standardized, interchangeable units, and spare parts are available in sufficient quantity. The rate at which such machines are going into production is still unsatisfactory.

Regarding this and preceding points it is up to the Technical Council, and the Gosplan to force through measures solving the problems, if not this year, at least in 1948.

(f) Switch over to combines performing a series of operations simultaneously. The crusher combine, which incorporates into a single frame primary and secondary crushers; concrete mixers which are

## CONFIDENTIAL

## CONFIDENTIAL

equipped with mechanisms for moving out the concrete, and many similar devices reduce the working area and labor consumption.

Machine builders must undertake preparatory research and design work now in order to put the projected new types of machines into production in the future.

- E N D -

1. Lack of spare parts for the machines and the unsatisfactory status of repair activities kept a number of complex machines in repair for as long as 8 to 10 months, and sometimes even a year. Current repairs of spare parts was carried out under make-shift conditions, the work being of undetermined quality.

## CONFIDENTIAL

- 11 -